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PROCAINE PENICILLIN AND INTERRUPTED PENICILLIN TREATMENT IN STREPTOCOCCUS AGALACTIAE MASTITIS

BY

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In penicillin treatment the aim has been to achieve bacteriostatic or bactericidal levels in the blood serum and otaer tissue fluids over a sufficient period of time to cause sterilisation of the infection. Various attempts have been made to administer penicillin in vehicles which would delay its absorption and so prolong its effects. In 1947 Herrell, Nichols and Heilman first drew attention to the procaine salt of penicillin and to the fact that effective blood serum levels could be maintained for 24 hours and even longer after a single administration of this salt. Further work by Miller, Verwey and Wilmer (1949), Young, Andrews and Montgomery (1949), Emery, Rose, Stewart and Wayne (1949) and others, has confirmed the prolonged effect of procaine penicillin, especially that of small particle size suspended in arachis oil containing aluminium monostearate.

To date (8.10.49) there is little published evidence of a veterinary nature to confirm medical findings. However, Doll, Wallace and Newton (1949) have compared levels achieved in cow sera with different penicillin preparations including procaine penicillin, to the advantage of the latter. Davidson, Wiley and Froost (1949) and Miller, Russo and Scheidy (1949) demonstrated a prolonged level in dogs injected with procaine penicillin. The obvious application of this knowledge to the treatment of mastitis awaits further publications, for the existing references do not provide information on the duration of effective levels in milks. Thus Bolton, Frayer, Cady and Waller (1949) do not record results later than eight hours after infusion. Murnane (1949) compared various retaining vehicles for penicillin treatment of the udder, including procaine penicillin in oil + 4 per cent. beeswax, but made no observations later than 24 hours after infusion. Neither group of workers reported therapeutic trials with procaine penicillin.

In the first half of 1949, procaine penicillin G in arachis oil with aluminium monostearate was made commercially available in this country for the treatment of mastitis. From the information provided, it appeared that effective levels (0·6 units per ml.) were still present 72 hours after infusion of 100,000 units per quarter, and the treatment recommended was two infusions at a 72-hour interval. This was considered to provide effective therapy over a six day period.

In this article preliminary results are reported on the levels of penicillin in milk after infusion of the udder with procaine penicillin and also the results of comparative therapy trials with this salt and calcium penicillin.

I.—PROCAINE PENICILLIN IN THE BOVINE UDDER

The object of the first part of the work was to ascertain the difference in the penicillin levels obtained by infusion of procaine penicillin as compared with calcium penicillin in arachis oil and beeswax.

Two lactating Ayrshire cows were selected and each animal was infused on two separate occasions making a total of four experiments. In the first instance, two quarters of the udder were infused with procaine penicillin and the remaining quarters received calcium penicillin. On the second occasion this procedure was reversed so that the quarters which previously received procaine salt now received the calcium salt and *vice versa*. This technique was observed with both animals. The procaine penicillin used was Boots* and another commercial company's alternately and the calcium salt was the Boots product. The dose throughout the series was 100,000 units per quarter administered in a single infusion from a collapsible mastitis tube. Samples of milk were withdrawn before infusion and at six and 12 hours afterwards and then at 12-hour intervals up to 72 hours. In the first series, samples were collected at six-hour intervals but it was not found necessary to repeat this in subsequent experiments. The method of assay used was that of Watts and McLeod (1948).

The results in these two cows are presented in Table I in units of penicillin per ml. of milk. In some instances, procaine penicillin is detectable in minute amounts at 72 hours whereas with calcium penicillin there is no detectable amount after 60 hours. The levels over the intervening period from the time of infusion show that calcium penicillin gives a relatively high level at six hours (715 units) as compared with procaine penicillin (175 units). At 12 hours the difference is less marked (calcium 156 units: procaine 102 units) but at 24 hours the procaine level is considerably higher (procaine 25·3 units: calcium 13·66 units) and at 36 and 48 hours the procaine result continues to be higher than the calcium. It can be seen that therapeutic levels of calcium penicillin are maintained in all quarters for 24 hours, and with procaine penicillin these levels can be continued for a further 12 hours (36 hours). Thereafter, the results in individual quarters tend to be irregular with both products.

To provide additional information, assays were performed on non-lactating cows. Two dry cows, each suffering from a *C. pyogenes* infection in one quarter, were treated with procaine penicillin. In these animals all quarters received 100,000 units procaine penicillin (Boots). Although the technique of assay was substantially the same

* The Boots Product was a sterile suspension of procaine penicillin 6·6 per cent. w/v in arachis oil with aluminium monostearate produced for these trials.

TABLE I

UNITS OF PENICILLIN PER ML. OF MILK AFTER ONE INFUSION OF 100,000 UNITS OF PROCAINE PENICILLIN

Hours after infusions	0	6	12	24	36	48	60	72
Experiment number								
1	0	160	10	2·5	1·25	0·16	0·00	0·00
2	0	320	10	10·0	5·00	1·25	0·16	0·00
3	0	320	160	40·0	10·00	0·62	0·31	0·00
4	0	320	320	40·0	5·00	0·00	0·00	0·00
5	0	80	80	10·0	5·00	1·25	0·00	0·00
6	0	40	80	20·0	2·50	0·62	0·00	0·00
7	0	320	80	40·0	10·00	2·50	0·62	0·08
8	0	640	80	40·0	20·00	5·00	1·25	0·62
Average	0	275	102·5	25·3	7·34	1·42	0·29	0·08

UNITS OF PENICILLIN PER ML. OF MILK AFTER ONE INFUSION OF 100,000 UNITS OF CALCIUM PENICILLIN

Hours after infusion	0	6	12	24	36	48	60	72
Experiment number								
1	0	40	40	0·60	0·31	0·16	0·00	0
2	0	80	10	1·25	0·16	0·16	0·00	0
3	0	2,560	320	20·00	2·50	0·00	0·00	0
4	0	1,280	640	20·00	2·50	0·00	0·00	0
5	0	320	40	2·50	0·31	0·00	0·00	0
6	0	160	80	5·00	1·75	0·31	0·00	0
7	0	640	80	20·00	2·50	0·31	0·08	0
8	0	640	40	40·00	5·00	0·52	0·08	0
Average	0	715	156·2	13·66	1·81	0·19	0·02	0

as that described by Watts and McLeod, it was not found possible to boil the udder secretion from dry cows, although in the original technique boiling milk for three minutes killed any contaminants without in any way altering the penicillin content. The udder secretion was therefore diluted 1:2 with distilled water and filtered through Seitz E.K. pads before assay. Secretion from the infected quarters was assayed separately from that of the remaining quarters which was pooled. Assays were continued at intervals for 168 hours (seven days). Results are presented in Table II.

In the uninfected quarters procaine penicillin could still be demonstrated at 120 hours (five days) at a level of 0·6 units per ml. and the effective duration probably was five to six days. In the infected quarters the persistence was slightly less, fading out between 96 to 111 hours (4½ days).

SUMMARY

1. The results presented above, although based on relatively few observations, indicate that procaine penicillin may *sometimes* be present in the milk of lactating cows in detectable amounts (0·08 units per ml. average) 72 hours after infusion of 100,000 units per quarter. It should be pointed out that in six observations out of eight, there was no detectable procaine penicillin at 72 hours (Table I.) Calcium penicillin similarly infused *occasionally* may be demonstrated in milk 60 hours later at an average level of 0·02 units per ml.

2. At 36 hours after infusion all quarters contained appreciable amounts of procaine penicillin (7·34 units per ml. average) whereas at the same time the calcium penicillin levels varied considerably from quarter to quarter with an average of 1·81 units per ml.

3. From these results it would seem that whatever level is taken for comparison, whether it be high therapeutic level, critical therapeutic level, or absence or presence of penicillin, procaine penicillin persists for about 12 hours longer than calcium penicillin.

4. Procaine penicillin may persist in the non-lactating udder for five days after the infusion of 100,000 units per quarter.

II.—THERAPY STUDIES WITH PROCAINE PENICILLIN AND CALCIUM PENICILLIN

Coincident with the above observations therapy studies had commenced in herds infected with *Str. agalactiae*. These studies were based on the following techniques.

METHODS

Pre-Treatment Tests.—All cows were sampled on three occasions before treatment. In some herds the first pre-treatment sampling was performed by the veterinary surgeon who had referred the herd to us, but at least two of the pre-treatment samplings were taken by one or other of the authors. In these samplings rubber gloves were worn and sterilised between cows in hypochlorite solution. Samplings were just prior to milking, in all except one instance, the afternoon milking. The third pre-treatment sampling was always on the same afternoon as the first treatment.

All samples were surface plated on blood aesculin agar. The inoculum was 0·1 ml. of milk dropped from a 30 dropper pipette. One of the pre-treatment tests was of quarter samples, the other two of composite samples. No cow was regarded as infected with *Str. agalactiae* unless this organism was isolated in at least two out of the three pre-treatment tests. Colonies were confirmed as those of *Str. agalactiae* by Lancefield's group precipitin technique and biochemical tests.

Treatment.—All cows in these herds were treated whether infected or not. The dose of either salt of penicillin was 100,000 units per quarter, on two occasions at a 72-hour interval. This treatment was coupled with application of penicillin ointment to the teats and the milkers' hands in an attempt to sterilise *Str. agalactiae* infection of the skin.

TABLE II

UNITS OF PENICILLIN PER ML. OF UDDER SECRETION AFTER ONE INFUSION OF 100,000 UNITS PROCAINE PENICILLIN PER QUARTER IN NON-LACTATING COWS

Hours after infusion ...	0	15	24	39	48	63	72	87	96	111	120	135	144	159	168
Name of cow and quarter infused—															
Betsy :															
R.F. infected quarter ...	0	80	40	20	20	10	5	1·25	—	0·3	0·0	0·0	0	0	0
Normal quarters pooled ...	0	640	2,560	80	40	40	20	2·00	—	0·6	0·6	0·15	0	0	0
Hendrie :															
R.F. infected quarter ...	0	—	640	—	160	—	10	—	0·30	—	0·0	—	0	—	0
Normal quarters pooled ...	0	—	640	—	160	—	80	—	1·25	—	0·6	—	0	—	0

Post-Treatment Tests.—All cows in the herds were sampled on three occasions within three weeks after treatment. The first post-treatment test was not performed earlier than four days after the last infusion, so as to avoid false negatives due to possible residual traces of penicillin. All samples were inoculated by the drop technique on to aesculin blood agar as in the pre-treatment tests. One sampling consisted of quarter samplings, the other two of composite samples. One set of composite samples were also enriched by incubation at 37° C. overnight and then stroked out on to crystal violet-aesculin-thallium acetate-blood agar. Colonies were confirmed as in the pre-treatment technique. One post-treatment follow-up test has been performed in each herd at periods of one to four months after treatment. These were examined by the direct methods of cultivation. No cow was regarded as free of *Str. agalactiae* infection unless all the post-treatment samples were negative.

The first herd (H—B) to be treated was a 24 cow herd of Red Polls under good conditions of management which contained ten animals infected with *Str. agalactiae*. The whole herd was treated twice with commercially available procaine penicillin, 100,000 units per quarter at 72 hour intervals. The results are presented in Table III.

TABLE III

ISOLATION OF *Str. agalactiae* BEFORE AND AFTER TREATMENT WITH PROCAINE PENICILLIN

Herd H—B : Total Cows = 24

Date of examination	Direct composite culture	Direct cultures from quarters	Cultures after enrichment
6.5.49	8/24	—	11/24
30.5.49	—	10/24	—
1.6.49	10/24	—	—
1.6.49 } 4.6.49 }	100,000 units procaine penicillin into each quarter on 1.6.49 and 4.6.49 respectively		
9.6.49	0/24	—	0/24
13.6.49	—	0/24	—
16.6.49	0/24	—	—
8.9.49	0/24	—	—

Numerator = Number of cows from which *Str. agalactiae* was recovered.
Denominator = Number of cows examined.
— = No examination made.

Out of a total herd of 24 cows, ten were found to be infected on two samplings out of three. No *Str. agalactiae* could be demonstrated in post-treatment tests including a follow up test on September 8th, 1949—three months later.

Many workers, including Watts and McLeod (1948), and Slavin (1946) have drawn attention to the considerable variation in penicillin levels which may occur between different quarters of the same cow and between different cows infused with the same unitage of penicillin. It is realised that our observations are not extensive enough to provide detailed information on the average duration of procaine penicillin in the bovine udder, but these observations did provide clear cut evidence that procaine penicillin is not invariably present in milk 72 hours after infusion of 100,000 units per quarter. It follows that the recommended interval of 72 hours between infusions will fail to produce a continuous bactericidal or bacteriostatic level in the udder of some cows.

In view of the successful results obtained in the first herd (H-B) which was entirely treated with procaine penicillin, we were led to consider whether continuous bacteriostatic or bactericidal levels were in fact necessary. Bigger (1944) first suggested that interrupted treatment with penicillin might be valuable. He based this suggestion on laboratory work with *Staphylococcus pyogenes*. Failure to sterilise broth containing staphylococci was due to the survival of a small number of organisms which he called persisters. These persisters were insensitive to penicillin because they were in a non-dividing state, penicillin only killing organisms which are about to divide. Unlike resistant strains, descendants of persisters are susceptible to penicillin. Bigger considered that interrupted penicillin therapy might allow persisters to multiply during the intermission so rendering them susceptible when treatment is recommenced. Downham and Christie (1946) described a successful result in one cow infected with *Str. agalactiae* which was treated with interrupted penicillin therapy.

In the light of these suggestions it was decided to continue our herd treatment studies on a comparative basis. Each herd was divided into two, each group containing equal numbers of *Str. agalactiae* infections as far as possible and equal numbers of clinical cases of *Str. agalactiae* mastitis. One group received 100,000 units of procaine penicillin per quarter at 72 hour intervals, the second group 100,000 units of calcium penicillin per quarter at 72 hour intervals.

The results are presented by herds in Table IV and the comparative results are summarised in Table V. A few brief notes follow on the mastitis history in each herd.

TABLE IV

ISOLATION OF *Str. agalactiae* BEFORE AND AFTER TREATMENT WITH PROCAINE PENICILLIN AND CALCIUM PENICILLIN

Herd	Total number of cows	Number in each treatment group	Pre-treatment positives by direct culture			Treatment	Post-treatment positives by direct or enriched culture			Follow-up positives by direct culture
			16.6.49	17.6.49 a.m.	17.6.49 p.m.	17.6.49 20.6.49	28.7.49	30.7.49	5.8.49	3 months later
E—H	26	13	8	7	8	Procaine penicillin	0	0	0	0
		13	8	8	9	Calcium penicillin	0	0	0	0
			10.7.49	18.7.49	19.7.49	19.7.49 22.7.49	27.7.49	29.7.49	2.8.49	2 months later
M—T	22	11	2	2	3	Procaine penicillin	0	0	0	0
		11	5	5	5	Calcium penicillin	0	0	0	0
			15.8.49	22.8.49	23.8.49	23.8.49 26.8.49	31.8.49	6.9.49	13.9.49	6 weeks later
B—R	50	22	11	12	12	Procaine penicillin	2	2	2	2
		28	11	12	11	Calcium penicillin	0	1	0	1

Herd E—H.—Over half the cows in this herd were secreting grossly abnormal milk. Management was poor, and hygiene virtually non-existent. After treatment, there was a striking clinical improvement which was still maintained three months later.

Herd M—T.—This herd had a recurrent mastitis problem. When first examined in 1947, infections were miscellaneous and most of them non-specific. On re-examination in 1949, *Str. agalactiae* dominated the picture. Management was ineffectual and co-operation poor.

Herd B—R.—A large commercial dairy. Not entirely self contained. Always about half a dozen clinical cases, although the cows involved changed from one examination to another. Teats were roughened and many had superficial abrasions. Attendants were unskilled.

TABLE V

COMBINED RESULTS OF PROCAINE PENICILLIN AND CALCIUM PENICILLIN TREATMENT IN *Str. agalactiae* INFECTIONS

Pre-treatment positives by direct culture			Treatment	Post-treatment positives by direct or enriched culture			Follow-up positives by direct culture
1st exam.	2nd exam.	3rd exam.		1st exam.	2nd exam.	3rd exam.	
21	21	23	Procaine penicillin	2	2	2	2
24	25	25	Calcium penicillin	0	1	0	1

It will be seen from Table IV that the few treatment failures which occurred were in Herd B-R. This was not unexpected owing to the size of the herd and the inexperienced personnel handling the animals. It was found that in the post-treatment samplings, one or two cows were intermittently positive, some on enrichment culture only. This type of finding suggests persistent skin infection, and the condition of the teats lent support to this supposition. On the third post-treatment test, teat swabbings were taken and *Str. agalactiae* was recovered from the teat skin of five cows confirming our opinion as to the cause of the breakdowns. The importance of skin infections has been amply demonstrated. (Imperial Bureau of Animal Health (1944). Edwards, Hughes and Taylor (1948)). However, we have not altered our assessment of treatment failure and any recovery of *Str. agalactiae* from milk, whether by direct or enriched culture in any post-treatment test, is listed as a failure.

Twenty-one cows infected with *Str. agalactiae* were treated with procaine penicillin, two of these cows resisted treatment (90·5 per cent. bacteriological cure) and out of 25 similar infections treated at the same intervals with the same unitage of calcium penicillin one cow failed to respond (96 per cent. bacteriological cure).

Although we have given no details of other infections in these herds, data was also collected on the treatment of other streptococcal infections (*Str. dysgalactiae, Str. uberis*) and also infections with *Staph. pyogenes*. This data gave no suggestion that either of the penicillins possessed an advantage over the other in the treatment of these infections. Most of the staphylococcal infections proved refractory to both types of treatment.

The difference in the results between the two treatments of *Str. agalactiae* infections is of no significance, but there is clearly no advantage in the use of procaine penicillin over calcium penicillin.

It is obvious that the cows treated with calcium penicillin at 72-hour intervals must have been without penicillin in their udders for at least 12 hours between infusions. These trials suggest that such interrupted penicillin therapy yields results comparable with those obtained in earlier trials with more closely spaced infusions (Report, 1949). The advantages to the practising veterinary surgeon of two infusions at a 72-hour interval are considerable, and it is considered that such interrupted treatment with calcium penicillin merits extended trial by others.

SUMMARY

1. Evidence is presented to show that two infusions of 100,000 units of procaine penicillin per quarter at an interval of 72 hours will not invariably result in a continuous bacteriostatic level of penicillin in the udder.

2. Comparative trials of procaine penicillin and calcium penicillin (100,000 units per quarter × two at a 72-hour interval) against *Str. agalactiae* infections revealed no advantage in favour of the procaine salt. Both salts in the above trials produced over 90 per cent. bacteriological cures.

3. The results obtained with the calcium salt of penicillin at a 72-hour interval suggest that interrupted penicillin therapy may be of value in *Str. agalactiae* infections.

Acknowledgments.—Our thanks are due to Sir Jack Drummond, F.R.S., for permission to publish these results and to the technical staff for their assistance.

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ROYAL SANITARY INSTITUTE CONGRESS

The President of Section D, Veterinary Hygiene, of the Health Congress of the Institute, to be held at Eastbourne from April 24th to 28th, 1950, is Mr. Harold Burrow, M.R.C.V.S., D.V.S.M., Professor of Medicine in the Royal Veterinary College, and Lieut.-Colonel J. A. Dixon, T.D., M.R.C.V.S., continues as Recording Secretary.

The Section will meet on the morning of Tuesday, April 25th when the President will give his address at 10 a.m. He will be followed by Mr. J. C. Greatorex, M.R.C.V.S., D.V.S.M. Lecturer in Veterinary Medicine, Royal Veterinary College, who will present a paper on some aspect of meat inspection. A paper on the new meat regulations will be given by Mr. George Tullis, M.R.C.V.S., D.V.S.M., Divisional Inspector, Ministry of Agriculture and Fisheries.

IMPROVED INTRAVENOUS TECHNIQUE IN THE LARGE ANIMALS

BY

E. O. LONGLEY, B.Sc., M.R.C.V.S.

The Needle

Those who have ever used Lang's spear-pointed intravenous needle will affirm the unique facility with which it penetrates even the thickest hide. The sharpest standard Record or other needle is blunt in comparison. As manufactured, however, Lang's needle has two imperfections: it is made of soft steel ; and as it is intended only for bleeding, its base is not designed for attachment to any nozzle. Thus it cannot have general use for intravenous work.

The use of soft steel is entirely proper in the manufacture of fine-gauge needles, to provide against their snapping. But with the large (15 or 16 gauge) needles in use for intravenous work in the large animals, this accident is out of all question and the use of the hardest possible steel is indicated on every count. Not only may the needle be made more slender for a given bore, without loss of strength and thus with obvious advantage ; it may be made sharper, and will remain sharp longer. This is particularly true of the spear-pointed needle, the essence of which is its cutting edge.

With these considerations in mind, the writer persuaded a surgical instrument manufacturer* to make a spear-pointed needle of the hardest available stainless steel, and with a Record-type mounting.

The spear-point, which on account of its composition is and can be easily maintained razor-sharp, was made finer than that of the Lang-pattern. An incidental advantage of this design of needle is that the possibility of cutting out a plug of skin which blocks the needle, as with the ordinary pattern (see Wright (1947)) is non-existent.

This needle, both for injections and bleeding, has given such satisfaction that the writer will never willingly employ the ordinary pattern again for this kind of duty, and cannot too strongly recommend its adoption for any venous entry.

Technique of Injection

The existing procedure for intravenous injections in the large animals, whether by gravity-feed or otherwise, must be acknowledged to be most clumsy and inept, involving as it does the preliminary intromission of the detached needle, the subsequent attachment of the tubing, opening the tap, initial lowering of the flask, and inspection for the reflux of blood, followed by its elevation, etc. (see Wright (1947)).

The Two-Way Tap.—The whole procedure may be completely simplified by the adoption for the purpose of the two-way stop-cock in common use for intravenous anaesthesia in man. This component is all-metal and comprises male and female Record-type mountings in alignment, with a side-arm (designed for the attachment of rubber tubing, but for the present purpose remaining free). The tap governing these three channels is of the single-arm type, which has great advantages over the common " butterfly " type illustrated in Wright's textbook (Wright (*op. cit.* p. 90)).

Method of Use.—Where this component is in use, the apparatus is assembled initially, complete from the container to the needle, with the tap set in alignment with the side-arm. (*a*, Fig. 1). The needle thus connected is thrust forthwith into the vein, when a free flow of blood from the side-arm of the stop-cock signals its proper entry, as in the figure. To initiate the injection the tap is then simply pushed by the thumb of the right hand (holding the needle-assembly) into alignment with the needle, *i.e.*, through 90°. (*b*, Fig. 1). This closes the port to the side-arm and opens the through-channel from needle to container.

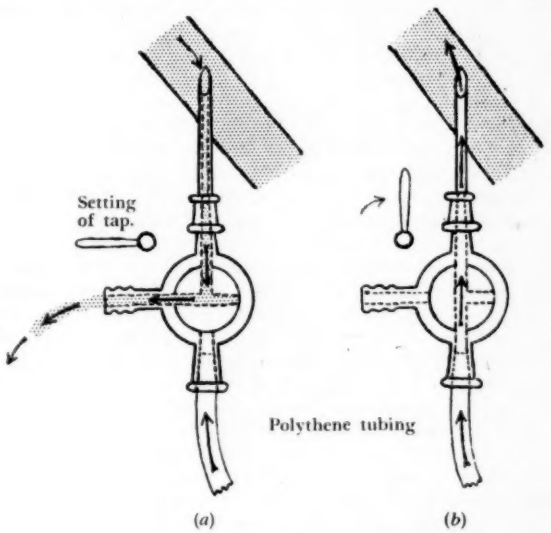

Fig. 1.

Illustrating use of Stop-cock for intravenous injections and direct flexible connection by plastic tubing.

At any time, the injection may be instantly suspended by slightly deviating the tap out of its alignment, and is as easily resumed by its re-alignment. If during the course of delivery the intravenous placement of the needle becomes in doubt, it is only necessary to restore the tap by the index finger of the right hand to its original position (aligned with the side-arm), when the resumption of flow, or otherwise, of blood from the side-arm supplies the answer. This also provides for washing out the needle with blood at the conclusion of injections, as with chloral hydrate.

It is to be noted that all these manoeuvres are effected with complete facility by the hand holding the needle, leaving the other hand free throughout—this being the special advantage, already mentioned, of the single-arm design of tap.

Other advantages of this system are:—

(1) Needles with special mountings as recommended by Wright (*op. cit.*) are no longer requisite, since the stop-cock in itself constitutes a form of mounting admirably suited to the purpose. Its side-arm rests against the thumb during intromission of the needle, affording unique control and power for the thrust through the skin, though with the spear-pointed needle advocated, little force is necessary to affect penetration.

(2) Glass " windows " or indicators, in the tubing connecting the needle or tap and the delivery apparatus, are also no longer requisite. By the same token, all manipulation of the level of the flask, etc., is dispensed with.

(3) The same principles apply, and the method is of equal value and facility, where positive pressure is in use as opposed to gravity-feed.

* Messrs. Down Bros., Mayer and Phelps, Ltd., London.

Flexible Connection to Needle

Where delivery is to be by gravity-feed, using the Wellcome " flutter-valve " in the ordinary way, the rubber tubing (minus its glass " window ") may of course be connected by drawing it over the rim of the female mounting of the stop-cock.

Plastic tubing has many advantages over rubber for surgical purposes, however, and of these plastics polyethylene (" Polythene ") is outstandingly valuable. For the present purpose " Portex " Drainage Tubing, " Standard Grade " (Translucent)* is specially recommended.

The translucence of this tubing ensures that its cleanliness and contents are at all times on view. It is boilable indefinitely without deterioration and is as imperishable, incorrodible, and unwettable as paraffin wax. It is flexible, yet of enormous tensile strength and virtually unburstable, so that for certain purposes (*q.v.*) it can serve where rubber tubing of such dimensions would fail completely. It is also cheap. And it is *plastic*.

The larger sizes can be used in place of and in exactly the same way as a rubber connection, but a very special value of this particular grade of Polythene is that the appropriate size may, without tying on or the use of adaptors, furnish direct connection between the nozzle of a syringe, and a female Record-type fitting, as of a needle or the stop-cock described. For this, Size 4* is ideal.

It is necessary only to insert a tapered metal dilator suitably heated (100° C.) into the lumen of this tubing to dilate it permanently to a degree such that it fits snugly and securely over a Record nozzle. And if a segment of the tubing at a suitable distance from this is dipped into boiling water, and on removal stretched by gentle traction (exactly as for heated glass), its diameter will reduce permanently to give a tapered end which will fit equally securely into the Record-type female mounting. The quality of the junction will be even better if the metal parts are themselves heated. Completely permanent, non-detachable connection to the nozzle may be made by slightly roughening or grooving the latter beforehand. Thus secure connections of a temporary or permanent nature, flexible, and of any length, may be effected direct between a syringe (or adaptor) and the needle or needle-assembly, overcoming the considerable objections to the direct (rigid) connection of a heavy syringe and the needle, for intravenous work.

It may be remarked that since with this tubing positive pressure of any degree may be applied, it becomes possible also to provide a direct flexible connection between the syringe and needle in the case of other than intravenous injections, as, for example, epidural and paravertebral anaesthesia, with obvious advantages. Additionally, and of special importance here, the minute bore of the tubing provides that only negligible amounts of the solution for injection are retained or wasted (=0·02 c.c./inch).

Technique for Injection Single-handed

Any technique which dispenses satisfactorily with the need for assistance has its own special recommendations in veterinary work. By combining the above measures, it becomes possible to administer any quantity of fluid intravenously to a large animal single-handed, and with a continuity of procedure and an expedience that are at first truly bewildering to anyone who has become accustomed to using the clumsy familiar routine. The technique for injection by syringe is simple.

The charged syringe, connected by plastic tubing to the tap-and-needle assembly, is conveniently slung round the operator's neck by a cord. The needle-assembly being retained in the right hand, the jugular vein is raised by the free left hand and the needle run into the vein. The left hand then takes the syringe and applies pressure to its contents, either manually, or by pressing the plunger to the operator's body. The right hand then opens the tap and delivery follows automatically at a rate determined by the degree of pressure applied. By employing the second method of applying the pressure, syringes of any size whatever can be invoked. This particular method is that used for the induction of anaesthesia with thiopentone in horses, as described in the following paper, and for which purpose it is uniquely valuable. No assistance (other than, usually, control at the head of the animal) is necessary from start to finish.

The general principle is obviously equally adaptable to delivery single-handed by gravity-feed ; and equally appropriate to delivery by positive air-pressure (as from Stockman's apparatus) where, additionally, the pressure may be raised in advance instead of only after introduction of the needle and connecting up, as hitherto.

Summary

(1) An improved design of spear-pointed needle, for intravenous work in the large animals, is discussed and recommended.

(2) By the use of the ordinary two-way stop-cock, complete simplification of the technique of intravenous injections is accomplished, whether by gravity-feed or positive pressure.

(3) Plastic tubing has many advantages over rubber, and can be made to provide direct flexible connection between the needle and syringe for any form of injection.

(4) A technique for the injection single-handed of any quantity of fluid, with complete continuity and expedience, is described.

Reference

Wright, J. G. (1947.) *Veterinary Anaesthesia.* (London.)

* Obtainable from Portland Plastics Ltd., 6, Victoria Street, London, S.W.1.

Conference on Mineral Supplements in Compound Animal Feeding-stuffs

A one-day conference, sponsored by the Compound Animal Feeding-stuffs Manufacturers' National Association, is to be held on January 26th, 1950, on the important subject of the inclusion of minerals in animal feeding-stuffs. The National Agricultural Advisory Service of the Ministry of Agriculture is co-operating in the arrangements.

The conference will be run in two sessions, divided by a luncheon break, and a full hour has been allowed at the end of each session for general discussion on the preceding talks, which are to be given by such eminent authorities as Professor Sir James Scott Watson, C.B.E., M.C., M.A., LL.D., Director-General of the N.A.A.S. ; Dr. H. H. Green, Senior Research Officer, Ministry of Agriculture Laboratory, Weybridge ; Mr. J. B. E. Patterson, M.SC., F.R.I.C., Provincial Advisory Soil Chemist, South-Western Area ; Dr. Ruth Allcroft, Permanent Research Officer, Ministry of Agriculture Veterinary Laboratory, Weybridge ; Mr. J. K. Dow, Agricultural Adviser to a compound manufacturer, and Mr. Frank Ewart Corrie, Agricultural Consultant.

The papers read and subsequent discussions will be published in booklet form.

Admission to the Conference, which will be held at The Wellcome Research Institute, 183-193, Euston Road, London, N.W.1, is by ticket only. Tickets may be obtained on application to the Secretary, C.A.F.M.N.A., Cereal House, Mark Lane, London, E.C.3, but the number available is limited.

THIOPENTONE (PENTOTHAL SODIUM) AS A GENERAL ANAESTHETIC IN THE HORSE

BY

E. O. LONGLEY, B.Sc., M.R.C.V.S.

INTRODUCTION

Henderson (1944) has used thiopentone (pentothal sodium) for the induction of narcosis in cattle, with complete satisfaction. Wright (1947) discussing nembutal, observes that " Investigations in the use of barbiturates in horses are chiefly academic, for the great cost of these agents precludes their use in most subjects," as is certainly true with ordinary usage.

This paper describes a technique for the administration of thiopentone in horses which reduces the dosage so considerably as to bring its use within economic reach in even the majority of equine cases. The technique employed is the most rapid possible administration and is so contrary to orthodoxy and teaching as to demand exposition. Any complete discussion of the pharmacodynamics and mathematical concepts underlying this policy is complex, and will be avoided for reasons of space, but an abstract of the theoretical argument is provided in an Appendix. An interesting discussion of the kinetics of intravenous injection is presented by Teorrel (1937).

In the Appendix it will be seen that the effect of the rapid injection of a quick-acting anaesthetic is dependent on (1) the animal, (2) the dose, (3) the rate of injection, and (4) the cardiac output at the time of the injection. This last is a determinant not hitherto given recognition, and it will be seen that the requisite dose is in fact and accordingly a function of the cube-root of the bodyweight of the animal.

It is of sufficient interest for insertion here that this theorem receives confirmation in the figures given by Wright (*op. cit.*, p. 169) for nembutal anaesthesia in the dog. If the values presented in Wright's table are examined, it will be seen that the recommended dosages, multiplied by the cube-roots of the respective weights, emerge as a virtual constant, as is seen in the table below:—

TABLE I

Body-weight (W lbs.)	Total dose (D grams)	Unit dose $\frac{D}{W}$ — mg. per lb.	$3\sqrt{W}$	$\frac{D}{W} \times 3\sqrt{W}$ = a constant
10	0·16	16·0	2·15	34·0
15	0·22	14·6	2·47	36·2
20	0·28	14·0	2·71	38·0
25	0·33	13·2	2·92	38·5
30	0·37	12·3	3·10	38·1
35	0·40	11·4	3·27	37·6
40	0·44	11·0	3·42	37·6
50	0·52	10·4	3·68	37·5
60	0·56	9·3	3·91	36·5
			Average	37·5

Table of Dosage for Nembutal in the Dog (after Wright) Analysed in Terms of Cardiac Output

The higher requirement in light animals and its converse have long been recognised clinically in all species, but have not, so far as is known, hitherto been offered explanation. It requires mention that the same relationship exists in respect of metabolic rate in the various subjects.

In the Appendix it has also been shown that the most rapid injection possible is not *per se* in any sense dangerous, *provided the dosage is correspondingly reduced*. This is the clue that was followed, and which led to the reduction of dosage of this expensive drug, whilst still retaining its effective action. In corollary, the rapid injection of intravenous anaesthetics *without* appropriate reduction in dosage is essentially and always fraught with grave danger to the patient. Further discussion of theory will here be avoided.

THIOPENTONE ANAESTHESIA

These observations comprise 26 trials in seven horses and 12 asses. No representative difference in action or dosage requirement has been observed between the two species, except in so far as bodyweight is concerned. All cases, excepting only the first, were treated in the standing posture and without other assistance than control at the head. In all but two instances, administration was effected in a medium sized loose-box. The animals have varied in weight from 266 lb. to 1,460 lb. The series included one animal of the hunter class of nervous disposition and in good condition.

Rate of Administration.—The time occupied by the injections has varied from two seconds to a maximum of 15 seconds. As the circulation-time, jugular vein to brain, in the equine, as shown in these observations, is of the order of 25 ± 5 seconds, the delivery time can never be with safety more than 20 seconds for administration in the standing animal. In the light of experience it was concluded that the optimum time for injection is between five and ten, not exceeding ten, seconds. Since the rate of injection controls the effectiveness of the dose, any extension of the period beyond this is uneconomical, while reduction below five seconds is not profitable in practice. This is probably on account of turbulence in the vein, which no doubt increases the length of the blood-drug column, having the effect of a slower rate of injection, which accordingly sets a limit to the possibilities in this sense.

Dosage.—The dosage employed by Henderson (*op. cit.*) in cattle was of the order of 1/10 grains per lb. bodyweight. He practised " rapid " administration, but cites no actual times, and describes the attainment of narcosis only. A fully surgical level of anaesthesia proper is to be recorded here with considerably smaller doses than those used by Henderson, and no doubt the greater efficacy of the drug in the present series relates to what is almost certainly a much more rapid injection-rate than was practised by Henderson.

For the dog and cat, Wright (*op. cit.*) prescribes for slow injection 1/7 to 1/4 grains per lb. (20 to 30 mg. per kg.), and for " rapid " injection occupying half to one minute, 1/8 to 1/7 grains per lb. (18 to 20 mg. per kg.). These are dosage levels that would be fatal (barring successful analeptic measures) with injection as rapid as is practised here.

The dosage employed by the writer in this series has varied from less than 1/20 to a maximum of 1/10 grains per lb. (approx. 7 and 14 mg. per kg.). The former is below the threshold of effective dosage; the latter provides surgical anaesthesia of some 20 minutes' duration.

Safety.—No anaesthetic casualty has occurred over the entire series, though a number of the subjects were old and debilitated and, accordingly, poor risks.

In one instance the anaesthesia was deliberately pushed by a second injection, after recumbency from the first injection, to the point of bulbar paralysis (total dose, 1/5 grain per lb. (27 mg. per kg.)) with total arrest of respiration. Artificial respiration, combined with endotracheal intubation and the exhibition of carbogen (oxygen + CO_2), resulted in the resumption of respiration after some 15 minutes.

At the first trial of the drug, and in the recumbent animal, the respirations arrested after the delivery of 1/6 grains per lb. (24 mg. per kg.). Artificial respiration for a period of seven minutes sufficed for their spontaneous resumption.

Thus, even with these excessive dosages and respiratory arrest, it was possible to sustain life, and it is evident that the anaesthetic risk with this agent, properly employed, is negligible.

Technique of Administration

To deliver comparatively large volumes of fluid at such speeds as are required, at a steady rate and reliably in a predetermined time, is not an altogether easy matter. In the previous paper the writer has described a technique for intravenous injection which was in fact largely evolved in face of this problem, and which is certainly the method of choice.

Strength of Solution.—The manufacturers' pack provides for a 5 per cent. solution of thiopentone, and this is the strength generally employed in anaesthetic practice. As is well known, on account of its high alkalinity in solution (*ca. p*H 10), it is important, as with chloral hydrate, that the solution should go intravenously only, and it is also integral that the strength of the solution is of importance. Obviously for the high blood concentration that is desired, a strong solution has every indication. Mackintosh and Bannister (1943) employ strengths from 2·5 to 20 per cent. with indifference. On the other hand, certain American workers prefer 2·5 per cent. solution even to the 5 per cent. In the present context compromise is called for. The writer has used from 5 per cent. to 33 per cent. solutions, but this latter strength was employed purely experimentally for observation of the effects with ultra-fast delivery (in less than five seconds).

For reasons that will be clear later constant *volumes* of solution ultimately were preferred to any given strength. The requisite dose is dissolved in a 100 ml. of distilled water, this usually providing a solution between 5 and 10 per cent. in strength, its precise concentration being a matter of indifference.

Control of the Animal.—Employing the technique described by the writer, no assistance whatever is required excepting a man at the head. In all but two cases, administration was effected in a medium sized loose-box, and, as will be seen later, it is not even important that there should be deep bedding.

Control of the Time Factor.—As is argued in the Appendix and as practice very adequately confirms, the time factor or rate of injection is of paramount importance for the efficacy of the method. Considerable variation occurs with any ordinary type of injection technique as a result of the personal equation, etc., and with a view to eliminating this variable the following technique was adopted. A second stop-cock of the pattern described in the preceding paper is placed in series with the other. With the apparatus assembled (100 c.c. Record-type syringe connected by polythene tubing, Size 4, to the stop-cocks and the needle) a few preliminary trials are made to determine that setting of the tap of the second stop-cock which will provide for delivery of the fixed volume of solution (100 c.c.) in ten seconds, when the maximum possible pressure is applied to the syringe by the forcible application of its plunger to the body of the operator. This "velocity control" tap is then locked in this position by its nut. This simple addition enables the individual to effect the injection in all cases in the desired time with an error which, for the writer, did not exceed about 10 per cent. (*e.g.*, 9 secs. ± 1 sec.), with no more attention to this aspect than that of applying full strength to the syringe. In other respects, the procedure is exactly as described elsewhere, and the total procedure from approaching the animal and raising the vein to withdrawing the needle and retiring need occupy no more than about a minute.

Course of Events.—With the injection concluded as described, the animal stands quiescent for a remarkably constant 15 to 20 seconds. It then suddenly stiffens, subsides back on to its haunches, and rolls on to its side into lateral recumbency, the time occupied from the first sign of action of the drug to full recumbency occupying a very constant five seconds. Two features deserve emphasis: (1) the course of events is exactly as described. There is never the slightest excitement or floundering about. (2) Not only does the animal subside on to its haunches, but in falling sidewards the head is characteristically flexed on the neck, away from the floor. Thus recumbency is assumed in such a manner that all risk of injury, *e.g.*, to the knees, muzzle, or eyebrows, is absent. This constant sequence is interesting and has been given an ingenious explanation by a medical colleague who suggests that the phenomena are determined by an overwhelming sense of fatigue so that the animal replicates, though in only three few seconds, its normal behaviour-pattern for assuming recumbency and it is noteworthy that in two bovines which this technique was assayed by the writer, he observed precipitate collapse first *in front* (never occurring in the horse). It is in consequence of these two characteristic features that the process demands neither space nor deep bedding.

Character and Duration of Anaesthesia

With the assumption of recumbency after this manner, the following features characterise the anaesthesia.

(1) *Respiration* is commonly in brief abeyance, but so swift and reliable is the process of "redistribution" of the drug (see Mackintosh and Bannister (*op. cit.*)) that it is always resumed spontaneously after a pause of ten to 30 seconds, and there is never the slightest occasion for anxiety. The first two or three breaths are shallow and irregular but a steady and satisfactory rhythm ensues at a rate varying from a minimum of four per minute towards the normal, depending on the depth of anaesthesia obtaining.

(2) *The heart* is accelerated, as for all species, and to between 60 and 80 beats per minute. Its action is regular and forcible.

(3) *The jaws* are not relaxed (Mayo's sign negative) and a varying degree of tonus is retained by the periocular muscles. Apart from this, muscular relaxation is total. The limbs are flaccid, exhibiting total loss of power, and may be flexed and moved freely in any direction. The lips are pendulous and the tail relaxed. The penis is pendulous at deep levels, the anal reflex absent or sluggish. The latter's return is early and a reliable sign of impending recovery.

(4) *The eyes* remain open. *The eyelid and corneal reflexes persist even to the stage of full bulbar paralysis.* The

constant feature is given italics because these tests, reliable with the innalation-anaesthetics, are entirely valueless with thiopentone and should be ignored. The pupil is generally contracted.

(5) *Nystagmus* may be present during induction where an inadequate dose has been given or the delivery has been too slow. It is absent where the technique has been adequate and anaesthesia obtains. Its appearance thereafter is a constant and reliable signal of returning consciousness.

(6) There is complete and generalised loss of cutaneous sensibility and a state of full surgical anaesthesia of depth and duration depending upon the dose, its rate of administration, and the idiocyncrasy of the subject. It was concluded that the response to a pinprick about the base of the ear is probably the best test for cutaneous sensibility in equines in these and other circumstances (" auricular reflex ").

The anaesthesia following the use of this technique, and as described, has varied from a minimum of some two to three minutes to a maximum of 22 minutes. Recovery to the ambulatory stage occupies from some 20 minutes to an hour. During recovery, power returns first to the head and forelimbs.

No post-anaesthesic delirium has occurred in any instance.

Recommendations.—In old and debilitated subjects, a dosage of 1/15 to 1/13 grains per lb. (9 to 11 mg. per kg.) generally will be adequate. In robust animals 1/10 grains per lb. (13 to 15 mg. per kg.) will afford anaesthesia as stated of upwards of some 15 minutes' duration. No heavier dosage than this has been essayed in the standing animal.

It may be observed that lean animals in hard condition are likely to require a greater unit dose than those in soft or plump condition. This results both from the higher *pro rata* cardiac output in such subjects, and their greater resistance to the effects of the drug. Notable differences are observable as between courageous animals and the opposite, both in respect of the ease with which they succumb to the anaesthesia, and recovery. When in doubt, the higher of two doses should be preferred.

No form of mechanical control whatsoever is required either for induction or during the anaesthetic period. At the first sign of recovery, however, it is recommended that limited control is applied since the animal may otherwise, particularly if disturbed, assume the " dog-sitting " posture but be unable to rise to all four feet. For this purpose, the writer has used simply a rope hitched round the off-fore fetlock, carried back round the near-hind, and forward to the near-fore fetlock, where it is secured, drawing the three legs together, and with control at the head. This has sufficed even for the heaviest cart-horse. The animals make no determined efforts such as characterise chloroform anaesthesia, owing to the sedative effects of the drug and the " neurasthenic " condition which it induces. This control is retained until it is adjudged that the animal is ambulatory. Where intravenous ether may have been superimposed as a maintenance anaesthetic, and as will be described in a later paper, no control whatever is necessary. The animals may simply be left quiescent for about an hour, during which time, if undisturbed, they will not stir. If roused, they will then rise easily and spontaneously to their feet.

The quietest possible handling is desirable, here as in all anaesthetic practice. Any excitement (augmenting the cardiac output) will militate against the efficacy of the dose.

The above dosage-data apply for the horse of weight 1,100 lb. (10 cwt. or 500 kg.). In lighter animals, as with dogs, a heavier rate will be required, while heavier animals will require less. The Table below gives the weight-adjusted dosages for animals from 600 to 1,600 lb. calculated from the above figures on the basis of the formula $P.^3\sqrt{W} = k$ (see Appendix). It will be noticed that this involves an increase of some 45 per cent. in the dosage-rating for a pony and a decrease of some 12 per cent. in the cart-horse, as compared with the standard animal.

TABLE II

Body-weight W lbs.	Unit dose, P mg. per lb.			
	4	5	6	7
600	2·9	3·7	4·4	5·1
800	3·6	4·4	5·3	6·2
1,000	4·1	5·2	6·2	7·2
1,100	4·4	5·5	6·6	7·7
1,200	4·7	5·8	7·0	8·2
1,400	5·2	6·5	7·8	9·1
1,600	5·6	7·0	8·5	9·9

Table of dosage of thiopentone for the horse. Total dose in grammes for various bodyweights and unit-dosages 4-7 mg. per lb. The unit doses are given, for greater convenience, in mg. per lb. since it is customary in this country to weigh in lb., while the drug is marketed in grammes.

Cost.—Employing this (" quick-shot ") technique, the dosage requirement is reduced 50 to 60 per cent. as compared with slow administration with its rating of 1/4 to 1/6 grains per lb., and it will be seen that the cost incurred for the horse falls between about 15s. and 20s. The writer has represented to the manufacturers that they should market a 4 gramme ampule for combination with the standard 1 gramme ampule, which should effect both convenience and economy. And that for this purpose, the phials of triple-distilled water which accompany the standard packing should be discarded, effecting a further reduction in cost. Pyrogens are of no significance in this context and ordinary distilled water will fulfil the purpose just as well, as it has on a number of occasions in the present study.

Discussion

In further consideration of the question of cost, it is a short-sighted policy that accounts only the initial outlay. The figure cited is already not unreasonable in the majority of equine cases, but in consideration of the practical advantages accruing from the use of this anaesthetic, it becomes definitely cheap. Any measure that can simultaneously cast and immobilise a horse in anaesthesia, and which is applicable single-handed, in a matter of no more than two to three minutes over all, would pay a heavy dividend even if its basic cost were very much higher. Without attempting to evaluate the saving of time to the busy practitioner himself, the services of several men to throw and control a heavy horse are a dead loss of their time to the client, who should be the first to appreciate and pay for this more expedient alternative. Furthermore, the traditional hobbles and casting harness may be scrapped.

Additional advantages by no means negligible are that, as has been practised here, even in the case of the largest cart-horse in the series (1,400 lb.), the animal may be treated with perfect safety in this manner under cover

in an ordinary loose-box, instead of in the open, with advantages including that it may be left with the simple control described and under lay supervision to make its own recovery, quite apart from the independence of weather conditions that this facility allows. It should be emphasised that in contrast with casting and chloroform, with their attendant violence and delirium, the anaesthetic by its very nature protects against crush-fracture.

Additional advantages are the very great safety margin of the agent, and the excellent quality of the anaesthesia which it provides, with the surgical convenience and better surgical prognosis that goes with this.

In concluding, it is of some interest to examine the question, what may be the precise potency of this anaesthetic ? The injected dose for a horse of 500 kg. bodyweight is of the order of 7 grammes. The writer estimates that the cerebral blood supply in the horse will be some 1/140 of the total cardiac output, (see Appendix). It follows that only 1/140 of the injected dose is delivered to the brain. This is 1/20 grammes or only 50 mg., *and not all of this will be absorbed and active*. Thus, some fraction of 50 mg. (less than one ten-millionth of the animal's bodyweight) suffices to fell it in anaesthesia !

ADDENDUM

Abstract of Theoretical Arguments

The time occupied by any given column of circulating blood to traverse any point in the circulation, is a constant. The rapid injection of a drug in time t creates such a column of blood, corresponding in length to t and the circulation rate. And the time occupied by this in traversing any point in the circulation, as, for example, the cerebral capillary-bed, is accordingly a function of t and approximately equal to t. The capillaries are not, strictly speaking, a point in the circulation, but as their length is of the order of 1 m.m., and the transit-time of blood through them of the order of one second (Dukes, 1942), they may be so regarded.

The blood-concentration B of any anaesthetic drug thus injected (and which determines its effectiveness), is obviously decided by the dose D and the volume of blood V into which it is received. Thus $B = \frac{D}{V}$ grammes per unit volume. It is also evident that for injections in time t seconds, $V = H.t.$, where H is the cardiac output over the time of injection. Thus the final concentration of drug in the blood ultimately leaving the heart for the brain is $\frac{D}{H.t.}$

When D is weight-proportional, as is the rule in veterinary work, it becomes $W.p.$, where W is the bodyweight and p the unit dose per unit of bodyweight. Since $H = k_1 \cdot W^{\frac{3}{4}}$ (Meeh's formula), the blood concentration BL becomes $k_2 . W^{\frac{1}{4}} . \frac{p}{t}$ from which it is seen that the blood-concentration resulting from a rapid injection is (1) proportional to the unit dose; (2) proportional to the rate of injection; (3) proportional to the cube-root of the bodyweight.

The absorption of an anaesthetic agent by the brain from the blood, however, is not a linear function of the blood-concentration. It is exponential in form, and the concentration C of the agent in the brain is governed by an equation of the form $C = q.B\,(1 - e^{-rt})$, where q and r are complex constants involving the diffusion-rates into and out of the tissues (*vide* Teorrel (*op. cit*). Such an equation, an *a priori* expectation, derives from his Equation 6 by eliminating the factors " Inactivation " and " Elimination," neither of which is applicable here). It follows that where the dosage bears a constant relationship to the bodyweight, $C = k_3 \cdot \left(\frac{1 - e^{-rt}}{t}\right)$, and that the difference between blood and cerebral concentrations resides solely in the expression $-t.e^{-rt}$, since B also varies as $\frac{1}{t}$. Thus t for a given animal and dosage is the sole variable, controlling the effect in accordance with this expression.

From this it follows further that reduction in the time of injection effects in the cerebral concentration not a hyperbolic increase as for the blood, nor an exponential increase as might at first sight seem to be the case, but a strictly limited, relatively slow, and almost linear increment. Otherwise expressed, the acceleration of the injection-rate increases the blood concentration, but at the same time reduces the transit-time of the blood through the brain. These effects tend to mutual cancellation, but the increased blood concentration is dominant, and the net result on cerebral concentration and anaesthesia is as stated. Thus no possible increase in the rate of injection of a properly adjusted dose can lead to an unsafe cerebral concentration. And in corollary, while reduction in the time of injection is potent, it is a strictly limited device for reducing the effective dosage.

The Cerebral Circulation

If it may be taken that the respiratory requirement of the brain in the horse and man will be *pro rata* the same, it is possible to estimate the cerebral blood-supply in the horse, though the data available are meagre. In man the brain is said to appropriate one-tenth of the blood supply (Samson Wright (1940)). The weight of the human brain is given as 2 per cent. of the bodyweight (Obersteiner, 1930)), that of the horse is one-seventh of 1 per cent. (Sisson, 1938)). Therefore, the brain of the horse is one-fourteenth of the human per unit of bodyweight, and it follows that if the latter appropriates one-tenth of the blood, the cerebral supply in the horse will approximate to 1/140 of the total cardiac output.

The Circulation Time

The use of thiopentone in the described manner provides a useful indication of the circulation time in the horse and, presumably, for other animals. In the horse the average figure emerging (jugular-to-head) is 25 seconds; in the ass it is 15 to 20 seconds. These periods must include transit from the jugular vein through each heart and the pulmonary circulation to the cerebral capillaries, and as this must be something more than three-quarters of the total circulation time in this circuit, figures of the order of 30 to 35 seconds for the horse, and 20 to 25 seconds for the ass, are indicated.

Summary

(1) Thiopentone is a valuable agent for general anaesthesia in the horse.

(2) The most rapid possible injection, occupying not more than ten seconds, is recommended. This practice reduces the dosage requirements more than 50 per cent., and to an economic level.

(3) The technique of administration and the safety and special features of the anaesthesia, are discussed. It becomes possible single-handed to bring animals into recumbency, anaesthetised, in about a minute, and in a confined space.

(4) The question of cost is discussed, and the pharmacological rationale is outlined in an Appendix.

Acknowledgments. I wish to thank Professor Edward Hindle, F.R.S., Scientific Director to the Zoological Society of London, who sanctioned my attention to this study; Professor E. C. Amoroso, Professor of Physiology at the Royal Veterinary College, and Dr. H. G. Epstein, Physicist to the Nuffield Department of Anaesthetics, Oxford, who kindly perused the original text; and Messrs. Abbott's Laboratories, Ltd., who placed generous supplies of the agent at my disposal.

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CLINICAL COMMUNICATION

EAR TREATMENT AND AURAL RESECTION IN THE DOG

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AND

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HAMPTON, MIDDLESEX

At the Veterinary Congress in London in August of this year, Dr. C. P. Zepp, of New York, President of the American Veterinary Medical Association, described an operation for correction of chronic ear trouble in the dog. Briefly, this operation consists of removal of a V-shaped section of the cartilage of the external auditory canal, this section being approximately one-third of the length of the canal. The remaining portion is incised in an inverted V-shape, the base remaining attached at its junction with the annular cartilage. This inverted V is in its turn inverted so that the cartilage is grafted ventrally. The deflected portion of the cartilage is sutured to the underlying subcutaneous tissue by means of catgut sutures, and the skin is sutured to the ear membrane with silk sutures, not including the cartilage.

Many dogs are sent to us with ear trouble, and nearly all of them are seen too late for local treatment to be of any use. Where local treatment is justified, however, ears are first cleansed with 1 per cent. cetavlon or bland soap and water. The use of irritating agents such as methylated spirit, ether, or hydrogen peroxide is not allowed. No powder is ever used as a dressing, nor any lotion that precipitates powder. The aggregated particles of powder, adhering as they do to desquamated epithelial cells, can only produce foreign body effects in the ear. We have found the following agents useful: anthisan cream (M. and B.) ; penicillin ointment ; lorexane cream (I.C.I.) ; sulphanilamide cream; gentian violet in 1 per cent. aqueous solution; planoform in oil (M. and B.), etc. Of these, mepyramine maleate (anthisan cream) has seemed to be of outstanding value in reducing inflammation and pain.

Where a case is presented showing pain or discomfort, anaesthesia is induced by means of intraval sodium (M. and B.), and a thorough examination is made by means of the auroscope. It is then decided whether the case is one that may be expected to benefit from resection. If operation is decided upon, anaesthesia is maintained by the use of oxygen and ether, and the patient is prepared by shaving both sides of the ear or ears, the forehead, the cheek and the infra-auricular area. After syringing thoroughly with 1 per cent. cetavlon, the area is smeared with propamidine cream, covered with sterile gauze, and bandaged. The operation is performed 24 hours later.

Since the London Congress, we have performed aural resection by Zepp's method on ten dogs. Anaesthesia varies from profound nembutal in good "risks" to morphia followed by oxygen—ether in poor ones. Continuous intraval sodium has been tried and intraval sodium followed by oxygen-ether. The operation field is surrounded by sterile cloths. Two pairs of long forceps are clamped on either side of the intended incision, one biting arm of each pair of forceps being within the ear canal and the other outside. The incision is carried from the top of the canal to a point on the skin level with the apex of the conchal cartilage. Haemorrhage is controlled as it arises, and it is usually slight. Cutting too deeply at the ventral end of the incision may result in severance of the superficial temporal artery or vein. When a little of the parotid salivary gland is exposed, it must be separated by blunt dissection from the conchal cartilage, and then divided—again by blunt dissection. This should be done with care, although one is fairly safe from the facial nerve itself. No doubt small nerve branches to the auricular muscles from the auriculo-palpebral branch of the facial nerve are torn, but we have seen no disfigurement following the operation. The cartilage is cut in the same manner as that described by Zepp, using straight scissors. In our first three cases, it was found that the tendency was to make the section of cartilage intended for graft too narrow. In these cases, too, we used nylon rather than inferior catgut to suture the cartilage graft to the subcutaneous tissue. In our remaining cases we used steel sutures of 32 standard wire gauge, going through skin, cartilage and ear membrane for all parts of the wound. Too many sutures are preferable to too few. In no case has the cartilage graft failed to "take," but we found that in using nylon an occasional suture gave way, due to subsequent inflammation and swelling.

Following the operation ears are dressed daily with propamidine cream, gauze and a bandage. Sulphanilamide powder or sulphathiazole with proflavine both make hard scabs with the drying blood and seem to slow down healing. Small doses of phenobarbitone are given daily to reduce head-shaking, but with steel sutures the dog seems to suffer little irritation.

The cases operated upon are roughly classified into four categories, *viz.* (a) Inflammation of the ear canal where foreign bodies (barley grass awns) were the predisposing cause ; (b) Inflammations probably resulting from parasitic infections ; (c) Tumour formations ; and (d) chronic inflammations from unknown causes.

In category (a) two cases were presented. A four-year-old wire-haired fox terrier had developed violent head-shaking in July. Advice was sought and local treatment was applied for about a fortnight. The dog was then brought to us, and we removed two barley grass awns from the affected ear, and expected the trouble to clear up. However, the dog was returned to us about two months later with a history of spasmodic attacks of head-shaking and of holding the head at a tilt. When we examined the dog again, the ear was discharging and there was ulceration right down the canal. We operated after giving a guarded prognosis. Three weeks after the operation the ulcers had healed, discharge had ceased, there was complete cessation of head-shaking, and the head was carried normally. In the second case, a middle-aged spaniel also had a history of having had barley grasses removed from both ears during the seeding season. Operation in this case, where the trouble was similar to the first, did not in our opinion effect a complete cure, but the amount of improvement obtained was such as to satisfy the owner that the operation had been worth while.

In category (b), two cases were characterised by intense reddening and itching. The dogs were a three-year-old wire-haired fox terrier and a four-year-old cross collie, and both had received local treatment for some time. Acute inflammation was present, and again the prognosis was guarded. Both dogs, however, were discharged from the hospital after two weeks, and subsequent contacts with the owners established that the results were excellent. In certain cases, therefore, operation may well be justified

where acute inflammation has not responded to local treatment.

In category (c) where a very old wire-haired terrier was presented, the result of resection and excision of the warty growths has not been traced, but the animal was discharged from hospital with the ears healing well.

Category (d), chronic inflammation, accounts for the remaining five cases. There is always a chronic ear condition with dirt, wax and discharge. Many cases are seen in spaniels. The canal is ulcerated and often the drum is perforated. Of these cases in dogs of middle and old age, we are satisfied that we have produced four successful results following the Zepp operation, and one is stated to be "better than it was."

Our results from this American operation have so far encouraged us to accept cases for aural resection which formerly we would have shunned. There is no doubt that the grafted cartilage, by virtue of its remaining hairless, prevents the further accumulation of debris at the bottom of the conchal cartilage.

ABSTRACT

[The Milk Ring Test for Detecting Brucella Agglutinins in Cow's Milk. HUDDLESTON, H. F., & CARRILLO, C. (1949.) *Vet. Med.* **44.** 6.]

This test is stated to be 90 to 95 per cent. accurate for detecting brucella agglutinins in the milk from *Brucella abortus* infected cows.

The authors describe a method of preparation of the stained antigen of which 0·1 ml. is added to 1 ml. of whole milk. The test may be read in from one to six hours, and in positive samples the stained antigen, being agglutinated, rises with the cream layer to form a sharp bluish ring at the top.

It is pointed out that the positive reaction is governed to some extent by the fat content, being slower as the fat percentage increases. The test is of no value in homogenised milk.

False positives are obtained with colostrum.

Work is continuing to correlate the results of this test and those of blood serum agglutination tests.

W. B. S.

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Erratum.—Abstract: "Procedures for diagnosing bovine venereal trichomoniasis and handling affected herds" (D. E. Bartlett) (*Vet. Rec.* **61.** 883)—paragraph 2 should read: "Samples must be protected from extremes of temperature and drying, and examined within a few hours of collection, although they may still be satisfactory at 18 hours (preputial samples) or longer (vaginal samples.)"

The year has closed with the Government taking the powers conferred under the Agriculture Act to enforce, if necessary, the cropping targets by setting a maximum limit to land under pasture. It is regrettable that this step should even be contemplated at a time when emphasis is shifting more and more upon the production of livestock, the traditional basis of British farming.—*Farming News.*

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WEEKLY WISDOM

He regarded himself as an unschooled amateur, having not realised that this feeling is the consequence of "a genius being him, who knows more than he learnt."—A. B. L. BEZNAK, reviewing in *Nature*, "Hopkins and Biochemistry, 1861-1947." (Cambridge: W. Heffer and Sons.)

NEW INSTRUMENTS AND APPLIANCES

A NEW RETRACTOR-DIRECTOR

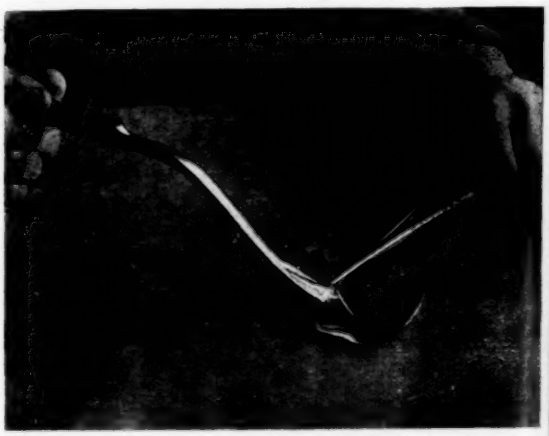
F. J. MILNE,

SURGERY DEPT., ROYAL VETERINARY COLLEGE

Whilst performing operations for the relief of ventral hernia and Caesarean section in cattle, using the lower abdominal method of approach, on occasions the writer has experienced difficulty in preventing omentum and bowel from being caught up by the suture needle during the closure of the abdominal muscles or aponeurosis.

Formerly, the fingers of the left hand were used as retractors to the detriment of these members on account of the numerous needle pricks and cuts sustained during the process.

The depicted retractor-director used in conjunction with a needle holder and a No. 3 Curved Triangular suture needle has been designed to overcome the disadvantages of finger retraction. The grooves on the curved plate guide the needle in the desired direction, the instrument being held either by an assistant or in the surgeon's left hand. A left-handed operator may also use the director as shown in the photograph.



The sutures uniting the edges of the last two or three inches of the incision are placed but not tied until the retractor has been withdrawn from the wound.

The instrument has been manufactured for me in stainless steel by Messrs. Arnold and Sons, London.

Acknowledgments.—I am indebted to Mr. E. F. Lewis, M.R.C.V.S., of the Medicine Department, Royal Veterinary College, who kindly took the photograph.

In 1950, as in previous years, the Department of Agriculture for Scotland will offer financial assistance to approved township committees and approved societies in Scotland, which provide, either by purchase or other arrangement, bulls of premium standard for the service of cows belonging to their members.

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The English Jersey Cattle Society has decided that any calf resulting from artificial insemination is to be inspected for type and colour prior to acceptance into the Herd Book whenever semen has been obtained from a centre where other bulls, in addition to Jerseys, are being maintained.

NOTES AND NEWS

Diary of Events

Jan. 18th.—Meeting of the Southern Counties Division, N.V.M.A., at Southampton (Polygon Hotel), 6 p.m.

Jan. 19th.—Meeting of the Western Counties Division, N.V.M.A., at Exeter (Royal Clarence Hotel), 2 p.m.

Jan. 21st.—Meeting of the Biochemical Society, at the British Postgraduate Medical School, Ducane Road, Hammersmith, W.12, 11 a.m.

Jan. 25th.—Meeting of the Lancashire Division, N.V.M.A., at Liverpool (Veterinary Hospital, Pembroke Gardens), 2.30 p.m.

Jan. 27th.—Annual Meeting of the North of Ireland Division, N.V.M.A., at the Veterinary Research Division, The Farm, Stormont, 2.30 p.m.

Jan. 27th.—Annual Meeting of the Mid-West Division, N.V.M.A., at Bristol (Berkeley Café, Clifton), 2.15 p.m.

Feb. 3rd.—Meeting of the Yorkshire Division, N.V.M.A., at Leeds (Hotel Metropole), 2.30 p.m.

Feb. 9th.—First Annual Ball of the Glasgow University Veterinary Medical Association, in the Prince of Wales' Halls, 350, Sauchiehall Street, Glasgow.

Feb. 14th.—Scientific Meeting of the Zoological Society of London, at Regent's Park, N.W.8, 5 p.m.

Next Meetings of Council and Standing Committees, N.V.M.A.

(*Committees at 36, Gordon Square, W.C.*1)

Wednesday, February 8th

11.0 a.m. Parliamentary and Public Relations Committee.
2.0 p.m. Organising Committee.
4.15 p.m. Home Appointments Committee.

Thursday, February 9th

10.0 a.m. Veterinary State Medicine Committee.
2.0 p.m. General Purposes and Finance Committee.

Friday, February 10th

11.0 a.m. **Council Meeting** at the Connaught Rooms, Great Queen Street.

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Examination of Animals Proposed for Insurance

Recommendations bearing on the scope of a veterinary examination for insurance purposes, drawn up by a Sub-committee of the Organising Committee, N.V.M.A., were some months ago discussed with representatives of the Accident Offices Association—central body of the tariff insurance companies.

As a result of these discussions the A.O.A. have now accepted a short form of report with regard to *horses* proposed for insurance and have agreed to the following being the scope of a veterinary examination:—

Inspect the stabled animal in the stable. Note any abnormality.

Examine:—

Teeth: with regard to age and condition of the animal and condition of the teeth.
Heart: auscultate.
Eyes.
Poll: withers and back.
Inguinal region.
Perineum.
Limbs and feet.

See the animal trotted, turned both ways and backed. Note marks of identity (age, height, etc.). Galloping, lunging or working in harness are not necessary to test the wind of horses of low value.

Negotiations have also taken place on the questions which the veterinary surgeon should be asked in respect of *all livestock* proposed for insurance and by agreement with the A.O.A. they have been reduced in number to the following:—

(i) Are you of the opinion that the proposer's estimated value is not excessive having regard to the condition of the animal?

(ii) In your opinion, is the risk a normal one, and do you advise the company to accept it?

(iii) If any of the animals are pregnant is there anything within your knowledge or in the appearance of the animals to indicate that the risk would be abnormal?

(iv) If to be operated on, are they in fit condition? State nature of operation and name of operator. Is there any reason to expect a change in condition?

(v) Is there, to your knowledge, any contagious disease on the premises or in the neighbourhood?

Should any insurer require a more extensive examination in any particular case it will be for the insurance company concerned to make their own arrangements with the veterinary surgeon.

The A.O.A. promised to adopt a suggestion that more space should be provided on report forms for particulars of an animal's markings.

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PERSONAL

Golden Wedding Anniversary of Mr. and Mrs. G. H. Locke

Many families have a long and honourable veterinary tradition, and notable anniversaries amongst these are a matter of congratulation and rejoicing for us all.

Mr. Richard C. Locke's eldest boy takes his final in June and if all goes well he will make in the profession the fourth veterinary generation of a family headed by that fine representative of the practitioner branch of our calling, Mr. George Harry Locke, who, elected President of the Royal College in 1934, went into partnership with his father (who died while in office as President in 1910) and has remained in Manchester ever since. All who know them, and so hold them in the utmost affection and esteem, will be glad to participate in spirit in the celebration of that life partnership, the golden anniversary of which the family gathered to celebrate in their home city on Wednesday last—January 11th. It was in January, 1900, that Mr. G. H. Locke married Alice Morna Conway, of Manchester, at All Saints Church, and we can be sure that, if it was at all possible for them, there was full representation of the three sons, the daughter and eight grandchildren at their private residence on this great occasion 50 years later. We would unite with them, and the large company also attending to do them honour, in wishing Mr. and Mrs. Locke many more years of health and happiness.

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Births.—Balls.—On December 15th, 1949, at Rose Hill Nursing Home, Dorking, to Izabel (*née* Rush), wife of Donald Balls, M.R.C.V.S., a daughter—Christobel Scott.

Grater.—On January 4th, 1950, at Salisbury, to Betty (*née* Slade), wife of George Grater, M.R.C.V.S., a daughter.

Taylor.—On December 31st, 1949, at 97, Ewesley Road, Sunderland, to Dora and George R. Taylor, a daughter—Elizabeth Jean.

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Forthcoming Marriage.—Shorter—Wright.—The engagement is announced between David Richard Shorter, M.R.C.V.S., only son of Mr. and Mrs. G. D. Shorter, of Ventnor Villas, Hove, and Caversham, Berks, and Ann Monica, youngest daughter of the late Mr. G. H. Wright, of Shanghai, and of Mrs. Wright, of Westlords, Willingdon, Eastbourne.

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Will.—Dr. Edward Simpson Shave, M.R.C.S., L.R.C.P., F.R.C.V.S., of Bexhill-on-Sea, Sussex, who died on August 22nd last, aged 93, left £10,463 8s. 4d. gross, £10,383 19s. 11d. net. Sole beneficiary is his wife, Mrs. Mary E. Shave.

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Argentine Veterinarian to Judge at Perth.—Our readers will be interested to learn that Dr. Hector F. Bonadeo, who has been selected by the Shorthorn Society and the Scottish Shorthorn Breeders' Association to judge at the Perth Show and Sale next February, is a veterinary surgeon. He and his brother, who are prominent Argentine Shorthorn breeders, own the famous El Cantor herd of Shorthorns which produced the Grand Champion bulls at the Palermo Show in 1947 and again in 1949.

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R.C.V.S. OBITUARY

Forbes, David Laing, B.Sc. (Edin.), Craigievar, Dalkeith, Midlothian. Graduated Edinburgh, July 12th, 1944. Died December 8th, 1949.

Mills, John Edward, M.R.C.V.S., Fronhafren, Caersws, Montgomery. Graduated N. Edinburgh, May 22nd, 1895. Died January 4th, 1950: aged 76 years.

Walpole, F. O. L., 62, Lampton Road, Hounslow, Middlesex. Graduated London, June 27th, 1888. Died January 8th, 1950; aged 86 years.

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Mr. Frank Walpole, M.R.C.V.S.

We record above, with deep regret, the death of Mr. Frank Orford Leopold Walpole, a member who filled a valued role in various aspects of our calling and, by reason of his character and abilities, made a host of friends alike amongst the most prominent and the "rank and file."

Qualifying from the London College in June, 1888, Mr. Walpole remained there in the capacity of Assistant Secretary. Indeed, it is said of him that he was "right hand man" to the Principal, Sir

George Brown, and Professor Wortley Axe at the time when that institution, in close liaison with the then Board of Agriculture, was concerned with enquiries into the epidemiology of such threatening epizootics as rabies and foot-and-mouth disease. This brought him into close touch with the leaders of the profession of his day—also with the personalities of the Smithfield Club. He will best be remembered, however, for his great interest in the dentistry of animals: a field in which he became an authority. As a lecturer in College he laid the foundation of many helpful friendships with the students, which extended long afterwards through the medium of extra-mural pupilship.

With an outstandingly kindly disposition was associated a retiring nature, which probably was responsible for the regrettable omission to produce that standard text-book on dentition and dental disorders in animals which undoubtedly he was well qualified to write. Moreover, it was a reticence which precluded his acceptance of office in the Central Veterinary Society, of which he was an esteemed and loyal member. Masonic honours, however, became his in the Worshipful Mastership of the St. Pancras Lodge, in which he had London rank conferred upon him.

For many years Mr. Walpole carried on a busy and successful practice in Highgate. Here he fostered the deep friendships he had formed and, in particular, that with Dr. Fred Bullock, the late Secretary and Registrar of the Royal College, who became Godfather to the son of his elder son, Mr. Basil Walpole, who qualified in 1923. To him and to his brother and sister we extend our deep sympathy in their loss. Mrs. Frank Walpole predeceased her husband by 15 years.

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Peter Lindsay

A Personal Appreciation

Peter Lindsay had practised in and around Liverpool for 27 years and he was well known and much loved by a large circle of friends and colleagues. A wide reader and an unbiased thinker, he was a good and painstaking clinician. In later years he acquired a love of antiques, particularly old silver.

I dislike a hackneyed phrase, but it would be so true to say of Lindsay that he was a man of sterling worth. He was a dour critic, but a staunch champion. He would never tolerate inefficiency or slip-shod methods and was never afraid to voice his criticism, but this was usually associated with a sample of that native humour which was one of the qualities that endeared him to his friends and disarmed those who disagreed with him. I only ever knew two other members of our profession who possessed in like manner his particular brand of humour—Bill Ironside and Hugh Gilmore—they were both his friends and I never expect, or indeed could hope again, so to enjoy such company as with those three.

I well remember at the Southport Congress an occasion at one of those delightful little parties thrown by Harry and Marjorie Hewetson in the early hours of the morning. Our esteemed colleague, the delegate from Ceylon was reading the hand of the guests—all too accurately for some!—and I told Lindsay that it was his turn. He looked at me quizzically over his glasses, then at his own hand, and said doubtfully: "He'll probably only tell me it wants a wash!" However, he was persuaded and the "palmist" began "You are a bachelor," he paused and then added: "it's too late to remedy that now." Lindsay interrupted him: "You're dead right; but that was a secret I was trying to keep between my maker and myself and now you've told everybody!" I wonder what else was read in that hand because the reader suddenly looked embarrassed, dropped the hand, asked Lindsay how old he was, and would say no more. Did he foresee so soon an end? I wonder.

Another instance, this time at an Edinburgh Congress. I accompanied Lindsay to Forsyths to buy a dress collar. "How much?" he asked, "Two and ninepence," was the reply. "Two and ninepence!" exclaimed Peter. "What would I be doing with a two and ninepenny collar on a Woolworth shirt?"

Like many Scots, he would try to convey the impression of being personally mean which he certainly was not. Though reserved almost to the point of secrecy about his own affairs, Peter Lindsay was ever ready to lend a helping hand to others and the writer has good cause to be grateful to him for many kindnesses dating from the time when, to a newly qualified graduate he sold, or, as he afterwards maintained, gave me his practice in Tamworth. Many of his old clients still remember him with affection and not a few still regret his departure!

Be that as it may, he always remained my best and most loyal friend and we enjoyed many days together and none more so than the week we had in London when he assisted me at the last International Horse Show.

Lindsay was very conservative in his dress and habits and nearly always wore a sombre grey suit and a bowler, though now and then he did let himself go and wore a trilby or even a cap. He often joined us on holiday in the north-west of Sutherland, and though on one occasion when tramping a hay-rick he did go so far as to remove his waistcoat, he refused to be parted from his bowler!

Peter loved to entertain his friends and was a grand raconteur. His ability to vary his facial expressions was remarkable and those of his intimates who had seen him portray "the bulldog breed"—with massive hairy chest bared, scarf round his neck, denture removed, lower canines protruding above his upper lip, and cap pulled well down, the whole presenting a most terrifying spectacle—realised that here was the peer at least of both Lon Chaney and Leslie Henson!

He was one of the Hon. Veterinary Surgeons at Aintree and was Chief Veterinary Officer for the Royal Lancashire Agricultural Society. He was a member of the Liverpool Agricultural Society, and attended regularly the functions of the Liverpool Rotary Club.

Lindsay was a staunch supporter and member of Council of the National Veterinary Benevolent Society, and an active member of the Lancashire Veterinary Association of which body he was Hon. Treasurer for a number of years and which office he held at the time of his death.

Peter Lindsay rarely missed a Congress of the "National" and those intimate and unofficial gatherings which help so much to make a congress worth while will lose much of their attraction without P. T. L.

There is no doubt that the strain of the war told upon him, and he failed to heed the warning of an attack of coronary thrombosis about two years ago. He would not let up, yet, though he had a serious recurrence ten days before the end, he remained cheerful and was joking with his nephew, Peter Shanks, and a doctor friend, and was in great form at 1.30 a.m., only a few hours before he died in his sleep.

Peter Thompson Lindsay was born 64 years ago, and lived the early part of his life in the little township of Shotts in Lanarkshire. He was one of a large family. He was a student at the Glasgow Veterinary College but transferred to Edinburgh where he graduated in December, 1908. He was profoundly influenced in his professional life by the late Dr. Bradley, of whom he was a great admirer. Just before the first world war he put up his plate in Tamworth—a step which he afterwards regretted and a procedure which he always later discouraged.

He served in the R.A.V.C., both at home and abroad, and attained the rank of Major. When he was demobilised he returned to Tamworth. In the Autumn of 1922 he took over the practice of the late Mr. Park at Woolton, Liverpool. Here he soon established a very sound reputation, amongst both his clients and his colleagues.

On Thursday, November 29th, 1949, a Memorial Service was held at Sefton Park Presbyterian Church, by the Rev. Wm. Sutherland. About 100 persons gathered to pay tribute to Peter Lindsay including the following members of the profession, and representatives of official bodies:—

Mr. Peter Lindsay Shanks, Messrs. J. C. Baird, J. Buchanan, E. R. Callender, G. O. Davies, R. B. Griffiths, H. R. Hewetson, D. R. Highet, A. Jennings, A. Ratter, A. C. Shuttleworth, A. N. Smith, H. W. Steele-Bodger, H. Sumner, J. H. White, J. W. Wilson: M. A. Soltys, J. Cooper and H. Holderness (representing the Royal Lancashire Agricultural Society), R. N. Bollans and A. J. Kinnish (representing the Liverpool Rotary Club), and J. Peacop (representing the Liverpool Agricultural Society).

In the course of his address, the Rev. Sutherland stated that although Lindsay was not a church-goer his life was so full of acts of practical Christianity that he had willingly agreed to the holding of the service. One could not wish for a better or more fitting tribute than that paid by the reverend gentleman. He likened Lindsay to the visitor whom an old friend had arranged to meet but at the last minute was unable to keep the appointment. He therefore bade his servant go in his place. Upon the servant enquiring how he would recognise the gentleman, he was told: "You will find a kindly man doing good to someone."

Of all too few could that be truly said, and we, his many friends, though the poorer for his passing, are the richer for having known him.

H. W. S.-B.

The Late Mr. Alexander Niven, M.R.C.V.S.

A Tribute

It was with feelings of great regret that many of us in the North-East heard of the death on Christmas Day of Alexander Niven, veterinary surgeon, Inverurie, recorded in your last issue.

Mr. Niven, who was a farmer's son and who spent some years on the farm before taking his veterinary diploma course at the Royal (Dick) College, Edinburgh, began the practice of his profession in Kintore, where he remained for a few years and from there removed to Inverurie over 30 years ago. There he was the veterinary surgeon and kind adviser to a large clientele who deplore the passing of a valued friend.

His profession was an absorbing interest to him. He kept himself abreast of the times in veterinary science and took great pleasure in imparting this knowledge to his pupils. His high ideals and devotion to his work will ever make him an example to the younger generation of veterinary surgeons.

He was at one time President of the North of Scotland Branch of the National Veterinary Medical Association—a position he filled with great acceptance to all its members.

He was a kindly friend and neighbour, courteous and helpful. The respect and esteem in which he was held was amply demonstrated by the large congregation who attended the funeral service in the South Church, Inverurie, where he was senior elder, and at the cemetery.

Mr. Niven was a staunch and devoted churchman whose passing deprives the church of a loyal member and his profession of one who was ever an example of the highest integrity.

J. A.

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ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Sheep Scab:

Cumberland.—Scales Farm and High Side, Embleton, Cockermouth, Cumberland; Tarn Side, Gamblesby, Penrith, Cumberland (Jan. 2nd).

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GLASGOW UNIVERSITY VETERINARY MEDICAL ASSOCIATION

Since the Glasgow University Veterinary Medical Association—a notice of whose first Annual Ball appears elsewhere—is still more or less unknown outside of the Veterinary School, we feel that the following information will be of interest to many readers:—

When Glasgow University took over the Veterinary College last October the constitution of the Students' Representative Council terminated. Instead the veterinary students now send two members to the much larger University S.R.C.

To look after the special interests of veterinary students the Glasgow University Veterinary Medical Association was formed and the Council of this Association now carries on the activities of former S.R.Cs. In this way the identity of the veterinary student body is maintained within the University and traditional functions such as "Field Days" with the "Dick" are being preserved. The founders of G.U.V.M.A. hope that the annual ball will become a link between students and graduates and a reunion looked forward to by all graduates who reside within reach of Glasgow.

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CATTLE FED ON GRAIN SORGHUM STUBBLE

The Brisbane correspondent of *The Times* states that the carcases of 57 Shorthorns and Herefords were examined with more than ordinary interest by 100 representatives of the meat industry, the graziers and the Government's depots, at Brisbane abattoir recently, because they represented prime beef which had been raised in the worst production months of Queensland's seasonal meat exporting industry. The cattle had been experimentally topped off on grain sorghum stubble at Peak Downs, the British Commonwealth food farm in central Queensland. The Commonwealth veterinary officer, Mr. E. A. Mylrea, pointed out that the results of this work showed that Queensland could increase beef exports at a time when normal pasture-fed cattle were not in a condition for the export market.

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Two British agricultural scientists are going to the United States to study American milk production and insect and plant disease control techniques. Dr. F. H. Dodd, of the National Institute of Research in Dairying, Reading, will make a two-month study of milk production techniques, and Dr. J. T. Martin, plant pathologist, will make a three-month study of recent American developments in the use of insecticides and fungicides.

UNIVERSITY OF LONDON EXAMINATIONS IN VETERINARY SCIENCE

Following is the Pass List for the December, 1949, Examinations in Veterinary Science of the University of London:—

First Examination.—Swann, Arthur Ian; Fisher, Betty Margaret; Sanford, John (all Higher School candidates).

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For failing to notify the police with all practicable speed that they had a cow suffering from tuberculosis, a farmer and his two sons were fined £4 with £2 15s. 11d. costs at Wragby.

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Scheme for the Control of Diseases of Dairy Cattle

Statement showing the Number of Undertakings Notified to the Ministry of Agriculture during the Quarter Ended December 31st, 1949

County	Undertakings Notified		Total Undertakings	Number of Cattle	
	During Quarter	Previously		Cows	Heifers
England					
Bedford	—	1	1	11	10
Berks	—	21	21	589	446
Bucks	—	5	5	128	136
Cambridge	—	—	—	—	—
Cheshire	—	39	39	1,340	611
Cornwall	—	—	—	—	—
Cumberland	—	2	2	96	90
Derby	2	119	121	3,359	1,970
Devon	1	68	69	922	523
Dorset	—	1	1	25	8
Durham	4	78	82	2,278	1,033
Essex	1	60	61	2,655	2,008
Gloucester	—	14	14	457	560
Hampshire	2	57	59	2,012	2,067
Hereford	—	3	3	159	162
Hertford	1	22	23	725	466
Hunts	—	—	—	—	—
Isle of Ely	—	—	—	—	—
Isle of Wight	—	—	—	—	—
Kent	2	40	42	1,034	690
Lancs	1	27	28	1,063	356
Leics	1	42	43	1,244	1,057
Lincs (Holland)	—	—	—	—	—
Lincs (Kesteven)	—	7	7	98	134
Lincs (Lindsey)	1	2	3	77	66
Middlesex	—	2	2	32	10
Norfolk	—	21	21	9 4	573
Northants	1	13	14	262	371
Northumberland	1	20	21	563	557
Notts	5	77	82	1,932	879
Oxford	1	2	3	90	117
Rutland	—	—	—	—	—
Salop	—	30	30	6,908	590
Soke of Peterborough	—	—	—	—	—
Somerset	2	53	55	1,702	1,026
Staffs	1	64	65	2,041	1,358
Suffolk (East)	1	5	6	62	125
Suffolk (West)	1	7	8	323	248
Surrey	—	20	20	719	426
Sussex (East)	1	24	25	792	524
Sussex (West)	—	26	26	696	495
Warwick	3	42	45	1,339	682
Westmorland	—	3	3	47	23
Wilts	—	9	9	2 7	118
Worcester	6	60	66	1,431	822
Yorks (E.R.)	1	23	24	367	325
Yorks (N.R.)	—	40	40	833	546
Yorks (W.R.)	—	57	57	1,542	541
Total, England	40	1,206	1,246	41,055	22,749
Wales					
Anglesey	—	10	10	158	91
Brecon	—	—	—	—	—
Caernarvon	—	14	14	231	98
Cardigan	—	22	22	515	305
Carmarthen	—	65	65	1,257	760
Denbigh	—	7	7	147	63
Flint	—	17	17	442	192
Glamorgan	—	24	24	397	215
Merioneth	—	—	—	—	—
Monmouth	—	6	6	137	88
Montgomery	—	5	5	55	18
Pembroke	—	5	5	157	202
Radnor	—	1	1	5	1
Total, Wales	—	176	176	3,501	2,033
Total, England and Wales	40	1,382	1,422	44,556	24,782

Notes.—(1) Operative periods of undertakings: 1 year, 356; 2 years, 67; 3 years, 999. (2) Undertakings renewed for further periods: 1 year, 31; 2 years 2; 3 years 39. (3) Undertakings not renewed at end of, or cancelled during, operative periods: 189. (4) The figures showing the number of undertakings notified during the quarter relate to entirely fresh undertakings and do not include undertakings renewed for further periods. Undertakings which have been cancelled or not renewed are not included in the figures for previous notifications.

County	Undertakings Notified		Total Undertakings in Force		
	During Quarter ending 30.9.49	Previously	Number	Number of Cattle	
				Cows	Heifers
SCOTLAND					
Aberdeen	—	11	11	568	335
Angus	—	9	9	564	327
Argyll	—	—	—	—	—
Ayr	—	2	2	77	64
Banff	—	—	—	—	—
Berwick	—	—	—	—	—
Bute	—	—	—	—	—
Caithness	—	—	—	—	—
Clackmannan ..	—	—	—	—	—
Dumfries	—	1	1	79	50
Dunbarton	—	1	1	12	10
East Lothian ..	—	—	—	—	—
Fife	—	19	19	697	477
Inverness	—	1	1	52	35
Kincardine	—	2	2	65	53
Kinross	—	3	3	81	62
Kirkcudbright ..	—	1	1	450	350
Lanark	—	1	1	36	22
Midlothian ..	—	—	—	—	—
Moray	—	—	—	—	—
Nairn	—	—	—	—	—
Orkney	—	—	—	—	—
Peebles	—	—	—	—	—
Perth	—	6	6	136	122
Renfrew	—	1	1	31	34
Ross-shire	—	2	2	126	36
Roxburgh	—	—	—	—	—
Selkirk	—	—	—	—	—
Stirling	—	3	3	137	140
Sutherland	—	2	2	39	34
West Lothian ..	—	1	1	17	29
Wigtown	—	2	2	185	119
Zetland	—	—	—	—	—
TOTAL	—	68	68	3,343	2,499

Notes.—(1) Duration of undertakings: 1 year, 22; 2 years, Nil; 3 years, 46. (2) Undertakings renewed for a further period: 1 year, 2; 2 years, Nil; 3 years, 1. (Included in the second column of the statement). (3) Undertakings expired and not renewed: 8 (Not included in the second column of the statement).

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DR. WINTERS ON SCIENTIFIC PIG-BREEDING

Addressing a meeting of the Institute of Meat on December 15th, Dr. L. M. Winters, Professor of Animal Breeding at Minnesota University, took as his subject "World Possibilities of Recent Developments in Breeding and Feeding in the U.S.A." He first described the phenomenal success which plant-breeders had obtained by applying the principles of genetics to the production of new commercial strains of maize. Hybridisation of the maize plant, which is bisexual, was given serious study from 1920 onwards. Within a matter of ten years, a number of inbred lines were established which gave growers a yield 20 to 25 per cent. greater than that obtained from previously existing varieties. Moreover it was possible to develop such qualities as resistance to unfavourable climatic conditions, resistance to pests, and uniformity of height (of practical importance in harvesting costs), and these—contrary to general expectations—have led to a greatly increased acreage of maize grown in the United States.

The plant breeders' successes with maize inspired Dr. Winters to apply the same general principles to pig-breeding. None of the existing breeds possessed all the qualities he wanted, so he crossed Tamworths and Danish Landrace, and by a process of selection and inbreeding he produced the Minnesota No. 1. This is "red," with black spots, light-jowled, long in the body and short-legged. It took ten years to establish. Minnesota No. 2, a black and white spotted strain, was derived from Large Whites crossed with Poland China. With both these and other new strains, Dr. Winters' aim was to secure hybrid vigour, a better survival rate, large litters, carcase quality to suit the American market, and quick growth on less food. He has been strikingly successful in attaining these objects, and Minnesota No. 2, for example, is much in demand by farmers, who find it crosses well with other breeds, making for more tender meat and stepping up the rate of growth. This is important in a country where the seasons tend to be more sharply defined, and where—in order to avoid large capital outlay on housing—stock must be got rid of before the cold weather sets in.

Such inbred lines, scientifically "pure bred" as opposed to ordinary pedigree animals, cost a great deal of money to produce, but in this case the Government of the United States defrayed part of the expenses. Another difficulty is the scarcity of people, trained in the necessary techniques, to apply these methods. Dr. Winters' department naturally includes an experimental breeding station, but the very nature of this precludes production on a scale large enough to satisfy demand. Consequently about six farmers were chosen to establish their own sub-breeds, within the framework of a new and unconventional breed association. On the large farms it was the practice to engage the services of expert geneticists, whose sole function was to supervise continued selection and inbreeding.

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PROPOSED CODE OF CONDUCT FOR THE COUNTRYSIDE

To enable everybody to enjoy the full benefits of access to the countryside under the provisions of the new National Parks Act, the Country Landowners' Association is urging the production, as early as possible, of a country code of conduct.

Lord Portsmouth, the deputy president of the association, told newspaper correspondents in London yesterday (says *The Times* of December 30th) that the association welcomed the new measure, but foresaw that a good deal of education, particularly of urban users of the countryside, might be necessary.

Lord Carrington, chairman of the legal and parliamentary committee of the association, said that much damage in the countryside was caused—mainly by townsfolk—simply through ignorance or negligence. Such damage often resulted in loss to agricultural production and in personal loss to the small farmer who suffered considerable hardship. There was no really adequate safeguard for owners or occupiers of agricultural land or woodlands in the form of compensation for damage to their buildings, livestock, woods, or implements. The National Parks Commission should take the earliest opportunity, in consultation with the representatives of farming and forestry and those with special concern in the beauty and amenities of the countryside, to prepare a country code of conduct. It should be an interesting and lively guide for townspeople and should be so produced as to gain their co-operation and goodwill in the full enjoyment of rural amenities. It should also be included in the curriculum of all schools.

CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the N.V.M.A.

MONILIASIS IN TURKEYS IN GREAT BRITAIN

Sir,—It is apparent from his letter (*Vet. Rec.* **61.** 874) that Dr. Gordon has misunderstood my reason for writing on the above subject (*Vet. Rec.* **61.** 806). If he will consult the reference I gave he will find that the position is quite different from what he has stated and that, in fact, the words "*first recognised in the U.K. this year*" appear. It was to correct this error that I wrote, not to claim priority in recognition, an aspect in which I have no interest.

I agree that British veterinary surgeons should have access to modern information on prevalent diseases of poultry, but I differ in the suggested method of presentation.

The investigation of poultry disease is a specialised procedure and I am of the opinion, based on a fairly lengthy experience, that the greatest assistance can be rendered to busy practitioners by encouraging them to submit carcases to the laboratory, when they are consulted on poultry mortality. The most up-to-date available information on control and preventive measures can then be incorporated concisely in the report.

Dr. Gordon draws a rather unfair inference from my statement of the disease appearing to be of relatively little importance in this country. This has been removed from its context where it was given as a reason for not publishing an account of the disease, and was therefore an opinion formed ten to 15 years ago. That it was not altogether unsound is shown by the fact that, until the past summer, not a single case had been seen in 25 years at Weybridge, where probably more material is handled than at any other laboratory in this country. Obviously the serious outbreaks which then occurred completely altered the position, and call for the further investigation which I understand is going on at several centres.

Yours faithfully,

Ministry of Agriculture and Fisheries, J. E. WILSON.
Veterinary Laboratory,
Eskgrove,
Lasswade,
Midlothian.

January 5th, 1950.